U.S. Army
Chemical Materials Agency
Program Manager for the Elimination of Chemical Weapons

Explosive Destruction System Quality Assurance Project Plan at Dugway Proving Ground

Final
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1. INTRODUCTION

Quality assurance and quality control (QA/QC) procedures are used during data collection and analysis to determine whether prescribed procedures are being followed and systems are operating within required limits. An effective QA/QC program provides assurance that deviations from established procedures and safe working conditions are identified in a timely manner. The objective of an effective QA/QC program is that workers and the public are protected from potential hazards. The QA/QC program also provides assurance that conclusions derived by analytical analyses are representative determinations.

2. CRITICAL MEASUREMENTS

Attachment A contains tables listing the “critical” measurements for the Explosive Destruction System (EDS) at the Dugway Proving Ground (DPG). Table A-1 lists the critical measurements and identifies the measuring devices, collection frequency, and frequency and type of additional quality control (QC) measurements associated with each measurement. For planning purposes, table A-2 contains a summary of analytical samples anticipated for this project. The actual number of samples may vary depending on circumstances. QA/QC procedures for air monitoring samples are provided in the Site-Specific Monitoring Plan (annex F to the EDS Destruction Plan).

3. RESPONSIBILITIES OF KEY QUALITY ASSURANCE (QA) PERSONNEL

Key QA personnel are identified in table 1. Each QA representative has an independent reporting chain within the organization that is independent of the EDS System Manager. Each organization is responsible for ensuring the QA representative is qualified to perform assigned duties.

Table 1. Key QA Staff

Title or Function/ Name	Immediate Supervisor/ Senior Manager
PMNSCM Onsite Representative	CMA-RMD
EDS System Manager	PMNSCM
EDS Site Safety Officer/ QA Manager	ECBC
PMNSCM Project Manager	PMNSCM
Monitoring QA Manager	ECBC Monitoring Branch Chief

Notes:

CMA	=	U.S. Army Chemical Materials Agency
ECBC	=	Edgewood Chemical Biological Center
EDS	=	Explosive Destruction System
PMNSCM	=	Product Manager for Non-Stockpile Chemical Materiel
QA	=	quality assurance
RMD	=	Risk Management Directorate

3.1 QA Representative Responsibilities

The QA representative's responsibilities include:

- Coordinating and conducting audits under the direction of the Product Manager for Non-Stockpile Chemical Materiel (PMNSCM)
- Ensuring that methodologies documented in the QA/QC plan are followed
- Ensuring personnel understand the QA aspects of their duties

- Documenting and communicating deviations from this plan to management, the EDS QA Coordinator, DPG, and PMNSCM

- Ensuring compliance with the QA objectives of paragraph 4.

3.2 Common Responsibilities

The following QA responsibilities are shared by all EDS participants:

a. *Training.* Each organization will conduct training for employees for the purpose of meeting requirements of local regulations and policies and this QA/QC plan. Personnel will be fully qualified to perform their duties. Each organization will maintain training records for assigned employees for 3 years after project completion.

b. *Control of Nonconformance and Corrective Actions.* Organizations will provide oversight of the work quality of employees. Audits and surveillance of job performance may be conducted on a noninterference basis. Workers will report nonconformances with established policies and procedures to area supervisors and QA representative.

c. *Document Control.* Each organization provides document control for the documents generated. Document control will be in accordance with procedures specified in this plan and by each organization's internal policies. The EDS System Manager will receive a copy of each document for the onsite files. At the conclusion of operations, the EDS onsite files will be released to DPG.

4. QA/QC OBJECTIVES

To provide data that meet project requirements, it is necessary to ensure that the level of data uncertainty is acceptable. To accomplish this, data quality objectives (DQOs) for precision, accuracy, representativeness, completeness, and comparability have been specified. These parameters, as a whole, define data quality. The following paragraphs define the DQOs for EDS operations.

4.1 Precision

Precision is the degree of mutual agreement between or among independent measurements of a similar property. Standard deviation (SD) and relative percent difference (RPD) are expressions of precision.

The precision objectives listed in table 2 represent either the maximum acceptable variability in a measurement, as determined by the results of replicate measurements, or the maximum amount of inherent random error acceptable in the measurement as a result of the measuring instrument used, as established by the instrument manufacturer. The goal of precision is to eliminate false negatives.

4.2 Accuracy

Accuracy is the degree of agreement of a measurement, or average of measurements, with a known or true value. In table 2, accuracy is reported as percent recovery or as percent or absolute bias. The closer the percent recovery is to 100 percent, the more accurate the measurement. Percent and absolute bias, on the other hand represent the difference between a measurement and its true value; therefore, the closer to zero the percent or absolute bias, the more accurate the measurement.

4.3 Completeness

Completeness is a measure of the quantity of valid data obtained compared to the quantity expected. During EDS operations, the completeness goal is 100 percent. However, the minimum threshold for completeness to obtain valid analytical results is 95 percent of the monitors and at least 95 percent of all other measurements (see table 2).

Table 2. QC Objectives for Precision, Accuracy, and Completeness[a]

Critical Measurement	Matrix	Method	Precision	Accuracy	Minimum Completeness (%)
HD	Liquid waste	GC	±25% RPD	±15%	95
GB	Liquid waste	GC	±25% RPD	±15%	95
pH	Liquid waste	9040B	±20% SD	±0.1 pH units	95
pH	Liquid waste	9041A[b]	N/A	±0.5 pH units	95
pH	Solid and non-aqueous waste	9045C	N/A	±0.05 pH units	95
Free Liquids	Solid waste	9095A or 9096	N/A	N/A	95
Corrosivity	Liquid waste	1110	±10 RPD	±2% of measured value	95
Ignitability	Solid or liquid waste	1010 or 1020A	N/A	±5°F	95
Heat of Combustion	Solid or liquid waste	ASTM D5468-02	±10% RSD	±10% of measured value	95
% Ash	Solid or liquid waste	ASTM D5468-02	±0.5 RPD	±2% of measured value	95
Specific Gravity	Liquid waste	ASTM D4052-96 D1429-95 D1217-93 or D5057-90	0.5 RPD	±2% of measured value	95
TC Metals	Solid or liquid waste	1311 (solids), 7061A/EPA206.3 7080A/EPA208.1 7130/EPA213.1 7190/EPA218.1 7420/EPA239.1 7470A/EPA245.2 7741A/EPA270.3 7760A/EPA272.1	±25 RPD	75 to 125% recovery	95
TC Organics	Solid or liquid waste	1311 (solids), 8081A, 8260B, 8270C, and 8151A	±25 RPD	75 to 125% recovery	95
Temperature	Absolute	Resistance temperature detector	≥0.05°F	±2°F	95
Relative Humidity/ Temperature	Air	Relative humidity and temperature transmitter	≥1 for RH ≥0.5 for T	±2 for RH ±1 for T	95

Table 2. QC Objectives for Precision, Accuracy, and Completeness[a] (Continued)

Critical Measurement	Matrix	Method	Precision	Accuracy	Minimum Completeness (%)
Pressure	Air	Gauges	≤0.005 psig	≤2% of full scale at 70°F	95
Pressure	Air	Differential pressure transmitter	0.5% of full scale when measured in psig	≤0.5% of full scale	95
Pressure	Air	Differential pressure transmitter	≤0.005 when measured as inches water column	≤0.5% of span	95
Air Velocity	Air	Air velocity transducer	≤2% of full scale	≤2.5% of full scale at room temperature, ±0.6% of reading from 32° to 122°F	95
Time	Absolute	Clocks	≤0.5 sec	≤0.3 min/yr	95
Time	Relative	Timers or stopwatch	≤0.5 sec	≤0.3 min/yr	95
Horizontal Wind Speed	Absolute	Anemometer	≤0.05 mph	≤0.2 mph	95
Horizontal Wind Direction	Absolute	Wind vane	≤0.5 degrees	≤0.5 degrees	95
Weight	Absolute	Scale/balance	≤0.2% of full scale (lb or g)	≤0.5% of mass calibration standard	100
Flow Rate	Absolute	Flowmeter	≤0.2% of full scale	≤0.5% of calibration standard	95
Volume	Absolute	Volumetric glassware	≤2% of full scale	≤5% of volumetric calibration standard	100

Notes:

[a] Quality Assurance (QA) objectives for precision, accuracy, and completeness for air monitoring are provided in the U.S. Army CDBCOM CASARM plan, 1999.

[b] pH measured by method SW-846 9041A is not as accurate a measurement as method SW-846 9040B. It is included as an alternative method in cases where, due to the sample matrix, pH measurement by SW-846 9040B is not possible.

Table 2. QC Objectives for Precision, Accuracy, and Completeness[a] (Continued)

Notes: (Continued)

ASTM	=	American Society for Testing and Materials
EPA	=	Environmental Protection Agency
g	=	gram
GC	=	gas chromatograph
mph	=	miles per hour
N/A	=	not applicable
psig	=	pounds per square inch gauge
RH	=	relative humidity
RPD	=	relative percent difference
RSD	=	relative standard deviation
SD	=	standard deviation
TC	=	toxicity characteristic

4.4 Representativeness

Representativeness is the degree to which a sample or group of samples is indicative of the population being studied. The following factors are addressed in the Site Monitoring Plan (SMP): sampling sites, process cycles, sampling frequency, sampling preservation, and sampling procedures. Together, they assure the collection of representative samples.

4.5 Comparability

Comparability is the degree to which one data set can be compared to another. Samples will be taken according to Standing Operating Procedures (SOPs) and standard reference methods recognized by the U.S. Environmental Protection Agency (USEPA) or other appropriate standards organizations to minimize variability within the sampling program. Data reduction, review, and validation will assess the comparability within the data set based on performance relative to the requirements of the method and this QA/QC plan.

4.6 Additional QA Objectives

Procedures and documents containing technical or QA requirements will be prepared, approved, and distributed in a controlled manner to ensure that current information and direction are available in the workplace. Changes to procedures and documents also will be controlled. Obsolete procedures and documents will be removed from the workplace when the new ones become available. The EDS System Manager is responsible for keeping site documentation up to date.

Identification, collection, indexing, maintenance, and final disposition of records are controlled by procedures in the Modern Army Recordkeeping System [Army Regulation (AR) 25-400-2]. This ensures preservation of documents and other media that prescribe technical or QA requirements, or provide evidence of QA achievement. Documentation retained as records of environmental compliance or compliance with

PMNSCM policies will be stored in a manner that minimizes the risk of damage or destruction. This may include maintaining dual storage at separate locations or single storage in facilities that meet National Fire Protection Association 232 requirements (current edition and addenda). During EDS operations, this is the responsibility of the EDS System Manager. At the close of operations, this will become the responsibility of DPG. The PMNSCM Onsite Representative and EDS QA Manager must approve exceptions to this requirement.

Operations and maintenance procedures will be used where the absence of these procedures could have an adverse effect on quality or safety. Such procedures will provide detailed work sequences, and sequence, type, and extent of QC inspections, tests, and acceptance criteria. Operations and maintenance will be performed under controlled conditions that assure a suitable working environment, compliance with all requirements, and availability of required equipment. DPG will retain documentation of QA inspections, compliance with requirements, and availability of equipment. The PMNSCM Onsite Representative and EDS QA Manager must approve exceptions to this requirement.

Changes to design and procedures will be evaluated to determine the impact to safety and environment. These evaluations will be documented. A configuration management program administered by PMNSCM will control changes.

5. MONITORING SITE LOCATIONS

Monitoring and sampling locations have been selected to include points where chemical releases would most likely be detected and places routinely occupied by workers engaged in chemical warfare materiel (CWM) operations.

5.1 Air Monitoring

Air monitoring is conducted to ensure that the EDS operations are performed safely and in accordance with this Plan. The primary objective of air monitoring is to detect conditions that may cause workers to be exposed to chemical agent vapors. Workplace exposure levels for the chemicals of concern are listed in table 1 of the Site-Specific Monitoring Plan. Air monitoring strategies and equipment are described in the Site-Specific Monitoring Plan (annex F to the EDS Destruction Plan).

5.2 Pressure Monitoring

Air pressure in the Vapor Containment System (VCS) will be continuously measured to ensure that a pressure differential is being maintained. In addition, the pressure drop across the high efficiency particulate air (HEPA) filters in the VCS air handling system is monitored to determine when the filters need to be changed.

5.3 Gas-flow Monitoring

Flowmeters are used to measure air or gas flow for specific equipment (for example, MINICAMS®) to ensure that the equipment is operating within specified parameters.

5.4 Meteorological Station

A meteorological station will be set up at the EDS site to measure wind speed and direction. The devices are located in an unobstructed area where representative measurements can be obtained.

5.5 Relative Humidity and Temperature

Relative humidity and temperature are monitored in the VCS to ensure conditions appropriate to operator safety are maintained. Guidelines for operator safety are summarized in appendix C, table C-1, of the Health and Safety Plan (HASP) (annex I to the Destruction Plan). The limiting conditions of operation for the EDS are based on the MINICAMS monitoring system that must operate in a temperature range of 0° to 40°C and 0 to 95 percent relative humidity.

6. SAMPLE HANDLING PROCEDURES

Numerous samples are generated during the course of EDS operations. These samples include Depot Area Air Monitoring System (DAAMS) tube samples, solid and liquid waste samples for agent screening, and solid and liquid samples for waste characterization. One characteristic that all of these samples have in common is that they must be transported from the point of collection to a laboratory for analysis. To ensure that analytical results can be properly attributed to the sample taken, various procedures are followed as described in the following paragraphs. For samples designated for Resource Conservation and Recovery Act (RCRA) analyses at an offsite Utah-certified laboratory, the samples will be agent screened and determined to meet the laboratory pre-defined acceptance levels for agent concentration prior to shipment.

6.1 Chain of Custody

Sample chain of custody (COC) adheres to COC documentation requirements described by the USEPA National Enforcement Investigation Center. Evidence of sample custody is traceable from the time the sample is collected until the sample is disposed of after analysis. At the time of collection, the appropriate part of the COC form is filled out. The original and one copy are placed in a plastic bag inside the secured sample transport container.

Regardless of whether the sample is transported to the onsite laboratory or shipped to an offsite laboratory, each sample bottle or tube is labeled and each sample container sealed using individual COC seals. Tracking the sample container to and from the field is accomplished by reference to the identification number on the seal. In addition, each sample container has a COC form. COC information also is recorded in the field logbook.

6.2 Shipping Containers and Custody Seals

For samples analyzed at the onsite laboratory, an appropriate sample carrier will be used that prevents the sample containers from breaking or becoming dissociated from their labels. When appropriate, ice packs will be used to maintain a temperature no greater than 4°C from the field to the laboratory.

Samples shipped to an offsite, contract laboratory are shipped in the same shipping container in which the empty sample collection bottle(s) were received. If for some reason the original shipping container cannot be used and a similar container is not available, the laboratory will be contacted to determine a course of action. Each shipping container contains packing material to protect the sample container during shipment. When appropriate, the shipping container will contain ice packs to maintain an internal temperature of no greater than 4°C from the field to the laboratory.

For sarin (GB) samples, acid preservation will not be added for volatile organics, toxicity characteristic volatile organics, and total metals. Sample holding times for these parameters will be 7 days.

6.3 Sample Identification

The sample identification number consists of thee parts. The first part is a one or two letter code designating the type of sample. The second part is the date and time the sample was collected. The third part indicates the sample's number in that day's sampling sequence. For example, the identification number LR 0428001517 003 indicates that this is a liquid rinse sample (LR), collected on April 28, 2000 (042800), at 3:17 PM (1517), and was the third sample collected that day (003). The sample type identifiers include:

- R Residue (any solid material from a waste drum)
- LR Liquid rinse (rinsate generated during operations or closure).

Other identifiers will be created if the need arises. Their creation will be noted in the field notebook.

6.4 Sampling Frequency

Waste samples are collected as required in the Waste Management Plan.

7. FIELD MEASUREMENTS

Field measurements are data collected by equipment operators with real-time or near real-time (NRT) instruments that do not require samples managed in a laboratory. The following paragraphs describe the instruments used to make field measurements. Field measurements related to air monitoring are in the Site-Specific Monitoring Plan (annex F to the EDS Destruction Plan).

7.1 Thermocouples

Thermocouples are calibrated by comparing the temperature reading on the digital readout unit to the temperature of a National Institute of Standards and Technology (NIST) traceable thermometer. If discrepancy occurs, the digital readout unit is adjusted to indicate temperature readings that agree with the NIST traceable thermometer. The calibration is performed in accordance with the specifications of the thermocouple manufacturer.

7.2 Pressure Sensors and Gauges

Pressure sensors and gauges are calibrated to a NIST traceable standard in accordance with the manufacturer's specifications.

7.3 Time Measuring Devices

Except for setting the clocks to local time, time measuring devices do not require calibration beyond the original calibration performed by the manufacturer. Manufacturer certification of QC is generally supplied with each instrument.

7.4 Wind Direction and Speed Measuring Devices

The anemometer and wind vane are operated in accordance with the requirements of the USEPA *Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV* (EPA-600/4-90-003) and the corresponding manufacturer's specifications.

7.5 Scales

If precision balances are used, they will be calibrated using NIST traceable weights and in accordance with the manufacturer's specifications.

7.6 Flowmeters

Flowmeters are calibrated in accordance with procedures specified in the USEPA *Quality Assurance Handbook for Air Pollution Measurement Systems: Volume II Ambient Air Specific Methods* and the corresponding manufacturer's specifications.

7.7 DAAMS Tube Sample Analysis

DAAMS tube samples are analyzed in an onsite laboratory. The analysis is performed using a gas chromatograph (GC) with a mass selective detector (MSD). See the Edgewood Chemical Biological Center (ECBC) Internal Operating Procedure (IOP) MT-13 for details. Copies of all IOPs will be onsite.

7.8 Maintenance Frequency

Table 3 presents the recommended calibration and maintenance intervals for EDS components and support equipment. Table 4 lists the recommended maintenance procedures for laboratory equipment.

8. CONTRACT HAZARDOUS WASTE ANALYTICAL LABORATORY

After wastes have been screened for chemical agents, samples will be sent to a state-certified laboratory for characterization. Final disposition of the wastes will depend on the results of the RCRA characterization. Waste characterization analyses are performed in accordance with USEPA approved methods.

9. DATA REDUCTION, VALIDATION, AND REPORTING

The following describe procedures for collection, organization of accurate information, clear and concise reporting of data.

9.1 Operations Data

Standardized forms and logbooks are used to record operations and sampling data. The EDS System Manager and the QA Manager review collected data in their entirety in the field. Errors or discrepancies will be noted in the operations field books. The EDS System Manager has the authority to institute corrective actions. At a minimum, the QA Coordinator is apprised of all deviations from standard protocol. A portion of the data and calculations are manually rechecked against the logbooks and original data sheets. Operations data are maintained in the EDS files.

Table 3. Recommended EDS Components and Support Equipment for Calibration[a]

Description	Calibration Interval	Drawing No./ Part No.	Source
Containment Vessel Subsystem			
Manifold Pressure Gauge	Annually/As Required	A68156	SPX
Hydraulic Nut Subsystem			
Pressure Gauge, Hydraulic Nut Pump	Annually/As Required	A69262	SPX
Rotary Agitation Subsystem			
Movi-Drive	As Required	TBD	SEW
Reagent Supply Subsystem			
Helium Regulator, 0 to 400 psig (Air Panel)			Matheson
Pressure Relief Valve			
Waste Transfer Subsystem			
Waste Drum Scales (Mechanical)	Annually/As Required	A69017 12D10 LP	FLOQUIP
Electrical Subsystem			
Watlow 96 Controllers (Vessel and Reagent Manifold)	As Required	96A1-FFDU-00GR	Watlow
Watlow 97 Controller	Annually/As Required	97A1-DDAU-00GR 97B1-DDDU-00GR	Watlow
Thermocouples	As Required	AS5106KU63PIS	Minco
DMMS (480 meters)	As Required	300T	Electro Industries
Explosive Opening Subsystem			
Fire Set	Annually/As Required	TBD	SNL
Helium Supply and Leak Detection Subsystem			
Helium Pressure Regulator	Annually/As Required	3816	Matheson
Vacuum Gauge	Annually/As Required	TBD	Ashcroft
DOT Helium Cylinder	Annually/As Required	Model 3030-580	Matheson
Calibrated Leaks (142 Helium Leak Detector)	2 years	PN 105967 A69033	ALCATEL
Leak Detector	As Required	142	ALCATEL
Pressure Relief Valve	As Required		

Table 3. Recommended EDS Components and Support Equipment for Calibration[a] (Continued)

Description	Calibration Interval	Drawing No./ Part No.	Source
Ancillary Equipment and Tools			
Torque Wrench, 3/8-inch Drive	Annually/As Required	TBD	Snap-On Tools
Torque Wrench, 1/2-inch Drive	Annually/As Required	TBD	Snap-On Tools
Multimeter, Fluke	Annually/As Required	Model 87	Fluke/Buckles-Smith
Calibrator, Fluke	Annually/As Required	Model 725	Fluke/Buckles-Smith
Calipers, digital	Annually/As Required	TBD	Buckles-Smith

Notes:

[a] Table identifies the recommended list of equipment, tools and parts for the EDS and support equipment for calibration. The recommended calibration intervals listed are from the vendor or manufacturers documentation, unless otherwise indicated in the calibration interval column.

DOT = Department of Transportation
psig = pounds per square inch gauge
TBD = to be determined

Table 4. Recommended Maintenance Procedures for Laboratory Equipment

Equipment	Procedure/Frequency	Spare Parts
Analytical Balance	Daily: Calibrate with standard weights, clean up spills. Annually: Service by TMDE/Manufacturer	
Gas Chromatograph/ Mass Spectrometer	Daily: Check gas supply, check column flow, check detector temperature. As Needed: Check level of oil in mechanical pumps and diffusion pump, replace electron multiplier, clean source, repair/replace jet separator, replace filaments. Semi-Annually: Check oil in mechanical rough pump and change, if necessary. Annually: Vendor supported preventive maintenance	Columns, chemical traps
MINICAMS®	Daily: Check gas supply, check temperatures and operating parameters. As Needed: Replace PCT, reactor tubes, analytical columns, clean sample lines, check pump oil level. Semi-Annually: Vendor supported preventive maintenance	PCT, reactor tubes

Notes:

PCT = preconcentrator tube
TMDE = Test Measurement and Diagnostic Equipment

9.2 Laboratory Data

Raw data are reduced and quantitative results reported as specified in each analytical method. The laboratory specifies the methods used for data reduction. A portion of the reduced results are checked manually against the bench sheets and raw data. The results are reported on forms similar to the USEPA Contract Laboratory Program Standard Forms. All laboratory reports are maintained in the EDS files.

9.3 Data Validation

Data validation involves the review of data and the acceptance or rejection of that data based on specific criteria. The criteria depend on the type and purpose of the data. The initial step in data validation is a thorough examination of all calculations involved in the reduction of sampling and analytical data. The data validation review is performed independent of the laboratory analyst(s) performing the analytical determinations. A chemist or QA officer will review 100 percent of raw analytical data and an independent reviewer will verify at least 20 percent of the data. The following paragraphs describe additional procedures for treatment of raw data to ensure clear and concise reporting of data.

9.4 Sampling and Operation

At least one series of calculations will be validated by someone other than the person who originally performed the calculations. All data are checked for completeness and are placed in the project data file. The data file also includes all documents associated with the calibration of the sampling and measuring equipment. Any redundant or backup data are used to assist in validating the operational data. The following criteria are used to evaluate field data:

- Use of sampling procedures described in this Plan
- Use of equipment that was calibrated and operated according to SOP, manufacturers' guidance, or other guidance approved by the EDS System Manager
- Chain of custody of samples and standard traceability.

This validation process includes all samples and collected information such as, but not limited to, leak tests, sample volume calculations, temperature and pressure readings, etc. The data are reviewed for correctness, transcription errors, and compliance with method performance and acceptance criteria.

9.5 Laboratory

Analytical data will be validated by laboratory QC and supervisory personnel by the criteria provided in this Plan. The following criteria will be evaluated to determine the validity of analytical data:

- Used approved analytical procedures
- Used equipment that was calibrated and operated according to approved procedures
- Achieved precision and accuracy comparable to that achieved in previous analytical programs.

9.6 System Performance Data Reporting

Pre-operational and operational reports will be prepared. Copies of the reports will be provided to PMNSCM and DPG.

9.7 Pre-Operational Survey

The pre-operational survey provides a basis for PMNSCM to authorize the start of chemical agent operations. This report documents the review of all pertinent documentation, inspection of all process and support equipment and facilities, and witnessing of selected system tests and operations. The pre-operational survey is prepared under the direction of the EDS System Manager and submitted to PMNSCM. A copy will be provided to DPG.

9.8 System Operations Reports

At the close of operations a final operations report will be prepared that summarizes project accomplishments. Each report will include information about the time frame covered by the report, the items that were processed, information on any releases of chemical agent outside of engineering controls, and any equipment or process failures and corrective actions taken. Operations reports will consist of the following sections:

- Executive Summary
- Introduction
- Project Description
- Data Collection Parameters
- System Performance Summary
- Conclusions
- Recommendations.

10. INTERNAL QC CHECKS

The following paragraphs address the internal field and laboratory QC checks implemented to ensure that the QA objectives specified in this plan are met. These are all instruments for which the QA objectives are based on the manufacturers' stated performance specifications. Furthermore, for measurements made using standard USEPA or American Society for Testing and Materials (ASTM) methods, the specific internal QC checks described in the methods are not described in this section. Instead, they are hereby incorporated by reference. The number and frequency of field QC samples to be collected during operations are described in tables A-1, A-2, and A-3 of attachment A to this Quality Assurance Project Plan (QAPjP). The specific QC and calibration requirements are those non-standard analytical methods to be used during operations are listed in table 5.

Table 5. QC Calibration and Challenge Schedule

Instrument	Quality Control Procedure	Frequency	Acceptance Criteria	Corrective Action
Colorimetric Tubes	A minimum of 10 percent of the colorimetric tubes shall be tested from each sample lot.	The tube lot shall be required to be tested monthly after initial acceptance test. Monthly testing on a previously accepted sample lot shall include testing one sample tube from the sample lot.	Manufacturer certification accompanies all colorimetric tubes and absence of obvious defects within the colorimetric tubes. Industrial chemical testing of the colorimetric tubes response within ±50%	
GC/MS/EI	IOP MT-13 for Air and MT-08 for extraction	Daily before first batch of sample is analyzed	See IOP	See IOP
	Laboratory matrix spike/matrix spike duplicate	One set per sample batch	The percent recovery ≥75% and ≤125%, and the RPD ≤25%	Recalibrate the unit and reanalyze the last batch of samples.

Notes:

GC/MS/EI = gas chromatography/mass spectrometry/electron ionization
IOP = Internal Operating Procedure
RPD = relative percent difference

10.1 Reference Material Standards Program

Reference standards are required to calibrate and challenge instruments and to spike QC samples. These solutions must be of known concentration and purity to ensure the validation of analytical results.

Chemical Agent Standard Analytical Reference Materials (CASARMs) for analytical analysis of chemical agents are developed and distributed by ECBC. CASARMs are chemical agent reference materials that are of characterized composition and purity.

All calibration solutions and standards used in the EDS operations are prepared and maintained under a laboratory standards tracking system. The system ensures that preparation, checking, documentation, storage, and disposal of standards are performed in accordance with the specified procedures and schedules appropriate for each analyte. Various aspects of standards tracking are described in the following paragraphs. The standard solutions used for MINICAMS calibration and challenges are made using pesticide grade solvent.

10.2 Preparation of Standard Solution

Standard solutions will arrive at the DPG EDS operation site in concentration ranges known as working standards, which can be handled with the same procedures as the pure solvents. Material Safety Data Sheets are readily accessible for the solvents and chemical agents in the laboratory and EDS Operations Trailer.

Working standards for the chemical warfare agents distilled mustard (HD) and GB are prepared by either the ECBC Chemical Operations Branch and are shipped to the project site by government carrier or by the onsite laboratory using CASARM material. Calculations used to determine how much CASARM material is needed to prepare a working standard of a given concentration are described in attachment B.

Solutions in vials will have the septum replaced before the vial is returned to cold storage. The old septum caps are disposed of as hazardous waste.

10.3 Storage and Handling of Working Standard Solutions

Each working standard solution is stored at a nominal 4°C in a refrigerator within the laboratory. All storage refrigerators and freezers shall have a certified thermometer that is checked once per day. The working standard solutions are allowed to warm to room temperature before being used for calibration or challenges. The working standard solutions are promptly returned to cold storage when immediate use is no longer necessary. Working standard solutions are exposed to as little light as possible.

10.4 Disposal of Working Standard Solutions

Residual calibration and QC working standard solutions are disposed of at the close of operations (after monitoring is completed) in accordance with all applicable RCRA, Department of Transportation (DOT), state, and local regulations. Any standard that has expired or is of questionable purity is disposed of when such condition is noted. The laboratory manager documents disposal of all solutions to allow for traceability and final disposition.

10.5 Chemical Measurement Calibration Requirements

Calibration standards are used to calibrate the MINICAMS and the GC. This type of calibration establishes a relationship between instrument response and the concentration of analyte in the samples. A calibration curve or a calibration point typically represents this relationship. Subsequent sample analysis results are then compared with the calibration curve or point to quantify the amount of analyte present in the sample.

10.6 MINICAMS Chemical Calibration Requirements

See ECBC IOP MT-16.

10.7 GC Chemical Calibration Requirements

See ECBC IOP MT-13.

10.8 Equipment Calibration Labels

Each piece of analytical and monitoring equipment is labeled with a visible indication of its calibration status. As a minimum, the label indicates the date of last calibration, the date due for recalibration, and the initials of the operator.

10.9 Calibration Documentation

Calibration documentation will include a detailed description of the associated calculations, equations, or software programs used. The equation used to calculate the amount of analyte in a sample from a calibration curve is validated and documented in writing before operations. The validation records for the equations are maintained in the monitoring files.

Any proposed changes to the approved calibration procedures, including the chemical solutions, SOPs, software, calculations, or equations, must first be validated and then submitted to PMNSCM, DPG, and Utah Division of Solid and Hazardous Waste (DSHW).

The EDS operators will establish and maintain a calibration file for the field monitoring and laboratory analytical equipment. As a minimum, the file will include the following:

- The procedure for calibrating each kind of monitoring and analytical equipment

- Frequency of calibration and the rationale for the periodicity
- Range of the calibration curve
- Calibration acceptance criteria
- Calculations, equations, and evaluation criteria used for analysis of calibration data
- Documentation of each calibration event
- Calibration source, including traceability of calibration equipment and chemicals
- A calibration list of all the monitoring and analytical equipment used to support EDS operations.

The calibration list of all the monitoring and analytical equipment will include the instrument serial number; most recent date of calibration; reference to the location and identification of the detailed calibration procedure, person, or agency that performed the calibration; calibration results; and the next date for recalibration. For equipment that requires frequent calibration, for example MINICAMS, the specific dates of calibration and the results are not required on the calibration list (but they must be on the equipment label).

11. PERFORMANCE AND TECHNICAL SYSTEM AUDITS

The EDS QA program includes both performance and technical system audits as independent checks of data quality. PMNSCM and the EDS QC Coordinator are responsible for ensuring that appropriate audits are conducted. It must be recognized that EDS treatment is a batch process and not continuing operations; therefore, all elements of the audits may not be able to be performed.

11.1 Performance Audits

Performance audits of sampling, analysis, and data handling are in addition to QC checks performed by the operator or analyst. Performance audits are unannounced and will consist of at least one blind sample delivered to the onsite laboratory from ECBC by arrangement with PMNSCM. The results will be compared to predetermined acceptance limits. Performance audits will also consist of at least one over-the-shoulder observation of the person recording and reading or interpreting the data. Calculations performed by computer will be reviewed using a set of "dummy" raw data for which the calculation results are known.

The following items describe performance audit planning and reporting:

- There will be one performance audit during EDS operations.
- A report of the performance audit results will be distributed to DPG, ECBC, and PMNSCM.
- Investigation and corrective action will be required when unsatisfactory performance is identified.

11.2 Technical System Audits

A technical system audit is a qualitative review to ensure that the quality measures outlined in the QA plan are in place. Technical system audit planning will consist of the elements discussed in the following paragraphs.

11.2.1 Scope. The technical system audit will be implemented under the direction of the EDS QA Coordinator to evaluate, as applicable:

- Organization and management

- Quality system audit and review (review of the yearly CASARM audit report documentation and yearly internal audit report including procedures for maintaining audit files)
- Personnel
- Accommodation and environment
- Equipment and reference materials
- Measurement traceability and calibration
- Test methods
- Handling of CWM items
- Records
- Certificates and reports
- Subcontracting of laboratory
- Outside support and supplies
- Issues (findings of previous audits).

11.2.2 Scheduling. A technical audit will take place during the pre-operations period. The start of chemical operations is contingent on the results of this inspection. Only one technical audit is planned; however, PMNSCM may require other technical audits during EDS operations if circumstances indicate such is necessary.

11.2.3 Audit Plans. An audit plan will be prepared, reviewed, and approved by PMNSCM and the EDS QA Coordinator. The audit plan will include:

- Organization and work areas to be audited
- Date and time of the audit
- Basis of audit criteria
- Names and duties of audit personnel
- Checklist that will guide the audit process.

If an audit is not planned for certain areas, the plan will include a statement of justification for not performing an audit of that subject.

11.2.4 Audit Personnel. Personnel who perform audits will not have responsibility for performing the work being audited but will have sufficient knowledge and be allowed sufficient authority and freedom to identify deficiencies and recommend effective corrective action.

11.2.5 Audit Execution. A pre-audit conference will be held between the auditor(s) and representatives of DPG, EDS operators, and PMNSCM site representative to introduce personnel, arrange for access to personnel, documents, and facilities, and to explain how the audit results will be reported.

Daily briefings will be held to inform the PMNSCM site representative and DPG of the progress of the audit, concerns, findings, and to exchange views and gather information.

A post-audit conference will be held between the auditor(s), the PMNSCM site representative, and DPG to inform them of preliminary results.

11.2.6 Audit Reporting. Results will be documented. The audit report will be distributed to EDS operations files, DPG, and PMNSCM.

12. CORRECTIVE ACTION

Each nonconformance identified during performance and technical system audits will be addressed in accordance with the following paragraphs. All EDS personnel have the responsibility to detect problems and implement corrective actions to minimize the effects of these problems on the work quality. The following paragraphs describe correction actions not specifically addressed elsewhere. These include corrective actions required as a result of noncompliance identified by a system operator or identified during a performance or technical system audit.

12.1 Identification, Segregation, and Return

The EDS System Manager will establish and implement procedures to ensure that:

- Materials, data, and items that do not conform to prescribed technical or quality requirements are marked, tagged, labeled, or otherwise identified as nonconforming.

- Nonconforming materials and items, whose use or further processing has been placed on hold pending resolution of the nonconformance, are segregated from the conforming material and items to the extent necessary to preclude their inadvertent use.

- Activities that do not conform to prescribed technical or quality requirements are documented in field or laboratory notebooks.

- Once materials and items have been identified and appropriate documentation prepared, the EDS System Manager must determine if the materials or items should be returned to the manufacturer, reworked, or destroyed, and then take appropriate action.

12.2 Documentation and Status

Documentation includes identification of the:

- Nonconforming activity, material, data, or item
- Noncompliance of the activity, material, data, or item with technical or quality requirements
- Individual reporting the nonconformance
- Current status of the activity, material, data, or item (on hold or conditions status)
- Individuals or organizations responsible for resolution
- Type and extent of corrective action that is required to resolve the nonconformance.

In addition, there will be indication of the importance of the nonconformance, information regarding the continuance or stoppage of work associated with each nonconforming activity, material, data, or item.

The status of each nonconformance and the progress of its resolution is documented and routinely reviewed to ensure prompt attention to conclusion.

12.3 Required Actions

Required actions are identified in the following paragraphs.

12.3.1 Remedial Actions. Remedial actions are those actions taken to correct the immediate noncompliance.

12.3.2 Investigative Actions. Investigative actions are those actions taken to identify the extent of the problem. For example, if an instrument is found to be out of calibration, the operator will conduct an investigation into the impact of this condition on all work performed since the last calibration.

12.3.3 Root Cause. Root cause refers to identification of the most basic cause that can be reasonably identified and that management has control over to fix.

Responsibility for implementing the corrective action is assigned to a specific person and that person's acceptance of the assignment is noted. The implementation and effectiveness of the corrective action is verified by personnel other than those responsible for carrying out the corrective action.

12.4 Reporting

Corrective action documentation will be distributed to PMNSCM, and a copy will be kept in the EDS QA files.

13. QA REPORTS

QA representatives provide information in sufficient detail and timeliness to assess the overall effectiveness of the QA program. The ECBC monitoring chief will provide copies of all monitoring and QC data (after verification and peer review) to PMNSCM, and DPG. There are four major types of QA reports.

13.1 Monthly Reports on QA Activities

This monthly summary report describes significant problems observed and corrective actions taken, changes to the QA organization, and notice of the distribution of revised documents controlled by the QA organization. Negative reports are required.

13.2 Monthly Reports on Measurement Quality Indicators

This monthly report includes the assessment of QC data gathering over the period, the frequency of analyses repeated due to unacceptable QC performance, and when appropriate, the reason for the unacceptable performance and description of corrective action taken.

13.3 Reports on QA Assessments

This report includes the results of internal or external technical system audits and performance audits and plan for correcting identified deficiencies. This is an event driven report with one report prepared for each audit performed.

13.4 Incident Reports

Incident reports will be prepared covering specific QA incidents. Incidents involving the release or suspected release of chemical agent outside of engineering controls require a written report within 48 hours of discovery. Each report will be assigned an incident report number and a category of occurrence (emergency, unusual, off-normal). The report will include sufficient detail to document the nature of the incident (including location, personnel, and equipment involved), when and by whom the incident was discovered, date and time notifications were made, immediate actions taken and results, results from monitoring or sampling and analysis performed, description of personal injuries and equipment damage (including personnel, equipment, and area decontamination requirements), description of the direct, contributing, and root causes of the incident, and the EDS Manager's evaluation of the incident including impact of the incident on the project and whether further evaluation is required.

14. CALCULATION OF DATA QUALITY INDICATORS

The following describe how the data generated by the internal QC checks are used to calculate the quantitative data quality indicators of precision, accuracy, completeness, and method of detection limit, so that they may be compared against the DQOs.

14.1 Precision

Precision is a measurement of the repeatability of a single measurement under a given set of conditions. For EDS operations, precision is stated in terms of standard deviation, percent relative standard deviation (%RSD), RPD, range, or relative range. When stated as standard deviation, precision is calculated as follows:

$$S = \sqrt{\frac{\sum (x_i - \bar{x})^2}{(n-1)}}$$

where

S	=	standard deviation
x_i	=	the ith measurement of the variable x
$\bar{x}$	=	mean
n	=	number of measurements.

and

$$\bar{x} = \frac{\sum x_i}{n}$$

When precision is calculated from three or more replicates, it is more commonly stated as %RSD and is calculated as follows:

$$\%RSD = \frac{S}{\overline{X}} \times 100$$

When only duplicate measurements are available to calculate precision, the %RSD is calculated by the following equation:

$$\%RSD = \frac{100}{\sqrt{2}} \times \left[\frac{2(x_1 - x_2)}{(x_1 + x_2)}\right]$$

where x_1 and x_2 are the two measurements.

Another way to calculate precision when only two duplicate measurements are available is RPD, which is calculated as follows:

$$RPD = \left[\frac{2(x_1 - x_2)}{(x_1 + x_2)}\right] \times 100$$

14.2 Accuracy

Accuracy is the degree of agreement of a measurement with an accepted or true value. For chemical analyses, it is most commonly represented as percent recovery (%R).

For measurements where matrix spikes are used to measure accuracy, the %R is calculated as follows:

$$\%R = \left[\frac{X_s - X_u}{k}\right] \times 100$$

where

x_s = measured value for the spiked sample

x_u = measured value for the unspiked sample

k = known value of the spike in the spiked sample.

When a laboratory control sample is used to measure accuracy, the %R is calculated as follows:

$$\%R = \left[\frac{X_m}{X_{SRM}}\right] \times 100$$

where

x_m = measured value

x_{SRM} = true value of standard reference material in laboratory control sample.

The bias may be calculated from the %R as follows:

$$\%bias = \%R - 100 = \left[\frac{X_m}{X_{SRM}}\right] \times 100 - 100$$

14.3 Completeness

Completeness is the amount of valid data obtained from a sampling or measuring event compared to the amount of valid data expected. Percent completeness is calculated as follows:

$$\%\text{completeness} = \left[\frac{n_v}{n}\right] \times 100$$

where

n_v = number of valid data points

n = number of measurements made.

14.4 Method Detection Limit (MDL)

The MDL is the minimum concentration of an analyte above true zero that can be detected and reported with confidence. The MDL does not take into account concentration of the analyte in a background sample and may be equal to or even less than the limit of detection. The MDL is calculated as follows:

$$\text{MDL} = t_{(n-1,1-\alpha=0.99)} \times S$$

where

$t_{(n-1,1-\alpha=0.99)}$ = student's t value for a one-sided, 99-percent confidence level and a standard deviation estimate with n-1 degrees of freedom.

S = Standard deviation of the replicate analysis

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ATTACHMENT A
SUMMARY OF CRITICAL DATA

Table A-1. Summary of Critical Data to be Collected for the Explosive Destruction System

Measurement Data to be Collected	Measuring Device	Collection Frequency	Frequency and Type of Quality Control Samples/Measurements
NRT Air Monitoring			
1. Determine presence of CWM in EDS workspaces	MINICAMS®	NRT monitoring is performed with a minimum frequency of once every 10 minutes.	Each MINICAMS is challenged with a field matrix spike sample once a day.
2. Determine CWM breakthrough for the carbon filter systems	MINICAMS	NRT monitoring is performed with a minimum frequency of once every 10 minutes.	Each MINICAMS is challenged with a field matrix spike sample once a day.
3. Determine presence of CWM in the carbon filter system exhaust	MINICAMS	In the event of a MINICAMS alarm at the carbon filter midbed, NRT monitoring of the filter exhaust is performed with a minimum frequency of once every 10 minutes until the filters have been changed.	Each MINICAMS is challenged with a field matrix spike sample once a day.
4. Determine presence of CWM in PDS	ICAM[a]	Real time monitoring performed continuously as needed	No formal calibration required
Confirmation Air Monitoring			
5. Confirm presence of HD/GB in the EDS workspaces	DAAMS/GC	In the event of a NRT monitoring alarm, DAAMS tube samples being collected for area monitoring are analyzed to confirm the MINICAMS alarm.	DAAMS tubes used for HD and GB confirmation sampling are within the manufacturer's recommended shelf life and the GC used for analysis is challenged with a field matrix spike sample once a day.
6. Confirm breakthrough of HD/GB in the carbon filter systems	DAAMS/GC	In the event of a NRT monitoring alarm, DAAMS tube samples are collected and analyzed to confirm the MINICAMS alarm.	DAAMS tubes used for HD and GB confirmation sampling are within the manufacturer's recommended shelf life and the GC used for analysis is challenged with a field matrix spike sample once a day.

Table A-1. Summary of Critical Data to be Collected for the Explosive Destruction System (Continued)

Measurement Data to be Collected	Measuring Device	Collection Frequency	Frequency and Type of Quality Control Samples/Measurements
7. Confirm presence of HD/GB in the carbon filter system exhaust	DAAMS/GC	In the event of a NRT monitoring alarm, DAAMS tube samples are collected and analyzed to confirm the MINICAMS alarm.	The DAAMS tubes used for HD and GB confirmation sampling are within the manufacturer's recommended shelf life and the GC used for analysis is challenged with a field matrix spike sample once a day.
Area Air Monitoring			
8. Area Monitoring to detect presence of HD/GB in EDS workspaces	DAAMS/GC	DAAMS tube samples are continuously collected. At 8-hour intervals the tubes are exchanged for fresh sampling tubes. The used sampling tubes are sent to the laboratory for analysis.	The DAAMS tubes used for HD and GB confirmation sampling are within the manufacturer's recommended shelf life and the GC used for analysis is challenged with a field matrix spike sample once a day.
Detection Monitoring			
9. Determine if decontaminated PPE or equipment meets Army decontamination requirements for maximum residual offgas before transport to laundry or shipment for disposal at an approved TSDF	MINICAMS	Upon completion of PPE decontamination procedures, vapor monitoring is conducted for the bag or container holding the decontaminated PPE.	Each HD and GB MINICAMS is challenged with a field matrix spike sample once a day.
10. Determine the presence of chemical agent vapors in VCS workspaces after decontamination for closure	MINICAMS	After completion of closure decontamination procedures, the VCS MINICAMS monitors are used to monitor the VCS workspaces.	Each HD and GB MINICAMS is challenged with a field matrix spike sample once a day.

Table A-1. Summary of Critical Data to be Collected for the Explosive Destruction System (Continued)

Measurement Data to be Collected	Measuring Device	Collection Frequency	Frequency and Type of Quality Control Samples/Measurements
11. Determine the presence of chemical agent in carbon filter systems after decontamination for closure	MINICAMS	After completion of closure decontamination procedures, the VCS MINICAMS monitors are used to monitor the filter system housing.	Each HD and GB MINICAMS is challenged with a field matrix spike sample once a day.
12. Determine the presence of chemical agent vapors for clean closure of the VCS workspaces	DAAMS/GC	When VCS is ready for clean closure, the exhaust system is turned off and the VCS sampled continuously for 8 hours using DAAMS tubes.	The DAAMS tubes used for HD and GB confirmation sampling are within the manufacturer's recommended shelf life and the GC used for analysis is challenged with a field matrix spike sample once a day.
13. Determine the presence of chemical agent vapors for clean closure of the filtration systems	DAAMS/GC	When VCS is ready for clean closure, the exhaust system is turned off and the filter housings are sampled continuously for 8 hours using DAAMS tubes.	The DAAMS tubes used for HD and GB confirmation sampling are within the manufacturer's recommended shelf life and the GC used for analysis is challenged with a field matrix spike sample once a day.
<u>Waste Characterization</u>			
14. Determine concentration of TC organics and metals in the aqueous wastes	GC for organics AA spectrophoto-meter for metals, as appropriate	When required, one liquid sample representative of the contents of the drum is collected for each liquid hazardous waste drum generated.	One duplicate sample is collected either (1) every shipment of less than 20 samples sent to the laboratory for analysis or (2) each group of 20 samples sent to the laboratory for analysis in a single shipment. One trip blank will accompany each shipping container carrying a sample or a group of samples to be analyzed for TC organics.
15. Determine pH of aqueous wastes	pH meter	Whenever aqueous waste is being prepared for disposal, a sample of the waste is collected and sent to the laboratory for pH determination.	The pH meter is calibrated per manufacturer's instructions; calibration solutions are prepared in accordance with established laboratory procedures.

Table A-1. Summary of Critical Data to be Collected for the Explosive Destruction System (Continued)

Measurement Data to be Collected	Measuring Device	Collection Frequency	Frequency and Type of Quality Control Samples/Measurements
16. Determine the degree of corrosivity of the aqueous wastes	Immersed steel coupon	When required, one sample of liquid waste is collected from the first drum of waste generated for each aqueous waste stream.	N/A
17. Determine the approximate degree of ignitability of the aqueous waste	Pensky-Martens closed-cup tester or Setaflash closed-cup tester	When required, one sample of liquid waste is collected from the first drum of waste generated for each aqueous waste stream.	N/A
18. Determine approximate heat of combustion of the aqueous waste	Calorimeter	When required, one sample of liquid waste is collected from the first drum of waste generated for each aqueous waste stream.	N/A
19. Determine the approximate ash content of the aqueous waste	Calorimeter/ analytical balance	When required, one sample of liquid waste is collected from the first drum of waste generated for each aqueous waste stream.	N/A
20. Determine approximate specific gravity of aqueous waste	Pychometer	When required, one sample of liquid waste is collected from the first drum of waste generated for each aqueous waste stream.	N/A
21. Determine the concentration of TC organics and metals in solid hazardous waste	TCLP and GC for organics TCLP and AA spectrophotometer for metals	When required, one solid sample representative of the contents of the drum is collected for each solid hazardous waste drum generated. If free liquid is visible in a solid hazardous waste drum, a representative sample of the free liquid also will be collected.	One duplicate sample is collected for either (1) every shipment of less than 20 samples of each matrix sent to the laboratory for analysis or (2) each group of 20 samples of each matrix sent to the laboratory for analysis in a single shipment. One trip blank will accompany each shipping container carrying a sample or group of samples to be analyzed for TC organics.

Table A-1. Summary of Critical Data to be Collected for the Explosive Destruction System (Continued)

Measurement Data to be Collected	Measuring Device	Collection Frequency	Frequency and Type of Quality Control Samples/Measurements
22. Determine the presence of "free liquids" (as defined by RCRA) in decontaminated dunnage waste	Paint filter test or liquid release test procedure	When required, one sample of decontaminated dunnage waste is collected from the first drum of waste generated.	N/A
23. Determine the approximate heat of combustion of decontaminated dunnage waste	Calorimeter	When required, one sample of decontaminated dunnage waste is collected from the first drum of waste generated.	N/A
24. Determine the approximate ash content of decontaminated dunnage	Calorimeter/ analytical balance	When required, one sample of decontaminated dunnage waste is collected from the first drum of waste generated.	N/A
Meteorological Data			
25. Determine wind speed	Anemometer	Once every hour or continuous recorder	N/A
26. Determine wind direction	Wind vane	Once every hour or continuous recorder	N/A
Process Control			
27. Monitor differential static pressure between the VCS and the area outside the VCS	Pressure gauge	Continuously measured but not recorded, gauge readout provides a visual indication to the VCS operators that a negative pressure condition prevails in the VCS.	N/A

Table A-1. Summary of Critical Data to be Collected for the Explosive Destruction System (Continued)

Measurement Data to be Collected	Measuring Device	Collection Frequency	Frequency and Type of Quality Control Samples/Measurements
28. Monitor differential static pressure between the VCS and the area outside the VCS to control the VCS carbon filtration system fan speed and ensure that vacuum conditions prevail in the VCS	Differential pressure transmitter	Continuously measured (every second) and recorded, this information also is electronically transmitted to the filtration system fan controller where it is used to control fan speed.	N/A
29. Monitor the differential pressure across the intake HEPA filter of the VCS carbon filtration systems to determine the need for filter changeout	Differential pressure transmitter	Continuously measured (every second) and recorded	N/A
30. Measure the pressure differential across the exhaust HEPA filter of the VCS carbon filtration system and the VCS vacuum system to determine the need for filter changeout	Differential pressure transmitter	Continuously measured (every second) and automatically recorded	N/A
31. Monitor air velocity of the VCS carbon filtration system exhaust to ensure that vacuum conditions prevail in the VCS and to determine the need for filter changeout	Air velocity transducer	Continuously measured (every second) and automatically recorded	N/A

Table A-1. Summary of Critical Data to be Collected for the Explosive Destruction System (Continued)

Measurement Data to be Collected	Measuring Device	Collection Frequency	Frequency and Type of Quality Control Samples/Measurements
32. Determine the air mass intake flow to the MINICAMS® monitors in order to determine the TWA airborne concentration of each analyte	Mass flowmeter	Continuously measured by the MINICAMS unit and automatically incorporated into the airborne concentration readout for the analyte(s) being monitored by the unit	Each MINICAMS mass flowmeter is calibrated annually.
33. Determine volumetric airflow to each DAAMS tube sampling station to determine the air mass intake flow to the DAAMS tubes, thus enabling determination of the TWA airborne concentration of each analyte	Airflow meter	Immediately after the beginning of each DAAMS sampling tube 8-hour sampling cycle, and just before the end of the 8-hour sampling cycle, the volumetric airflow of each DAAMS tube is measured and recorded.	The DAAMS rotameters are calibrated annual.
34. Monitor temperature inside monitoring shed to ensure adequate conditions for equipment operation and worker comfort	Temperature transmitter	The temperatures in the monitoring shed are measured once every hour and automatically recorded.	N/A
35. Determine time and date that each waste container is sent to temporary storage	Watch and calendar	For each drum of waste removed from the VCS, the time and date of removal are noted and recorded, along with the waste drums identification number.	N/A
36. Determine weight of a waste container removed from the VCS	Scale	The weight for each waste container is measured and recorded along with the container identification number and date and time when the container is removed from the place of generation to be sent to temporary storage.	N/A

Table A-1. Summary of Critical Data to be Collected for the Explosive Destruction System (Continued)

Measurement Data to be Collected	Measuring Device	Collection Frequency	Frequency and Type of Quality Control Samples/Measurements
37. Establish time and date that a waste drum is placed into or removed from service	Watch and calendar	Each time an empty or partially-filled waste drum is loaded into a waste receptacle station in the VCS to be filled with hazardous waste, the time and date are recorded along with the container identification number. Each time a partially-filled hazardous waste drum is removed from a waste receptacle station in the VCS to be sent to temporary storage, the time and date are recorded along with the container identification number.	N/A

Notes:

[a] In the event of a potentially exposed worker, there is a MINICAMS located in the PDS to perform low-level NRT monitoring.

AA	=	atomic absorption
CWM	=	chemical warfare materiel
DAAMS	=	Depot Area Air Monitoring System
EDS	=	Explosive Destruction System
GB	=	nerve agent
GC	=	gas chromatograph
HD	=	distilled sulfur mustard
HEPA	=	high efficiency particulate air
ICAM	=	improved chemical agent monitor
MS	=	mass spectrometer
N/A	=	not applicable
NRT	=	near real-time
PDS	=	personnel decontamination station
PPE	=	personal protective equipment
RCRA	=	Resource Conservation and Recovery Act
TC	=	toxic characteristic
TCLP	=	Toxicity Characteristic Leaching Procedure
TSDF	=	treatment, storage, and disposal facility
TWA	=	time-weighted average
VCS	=	Vapor Containment System

Table A-2. Summary Estimate of Analytical Samples

Sample Source	Analyte	Analytical Method	Turn Around Time	Number of Sampling Events	Samples per Event	Total Number of Samples	Duplicate Samples[a]	Replicate Samples[a]	Trip Blank	Grand Total
Solids Waste Samples										
	Chemical agent	Extraction and GC/MSD or GC/FPD/ECD	Normal	22[b]	1	22	0	0	0	22
	Free liquid	9095A or 9096	Normal	22[b]	1	22	0	0	0	22
	Corrosivity (if <20% liquid)	9045C	Normal	22[b]	1	22	0	0	0	22
	Ignitability	1010 or 1020A	Normal	22[b]	1	22	0	0	0	22
	Heat of combustion	5050 or ASTM D5468-02	Normal	22[b]	1	22	0	0	0	22
	% Ash	ASTM D5468-02	Normal	22[b]	1	22	0	0	0	22
	TC organics	1311 and 8260B, 8270C, 8081A, and 8151A	Normal	22[b]	1	22	3	3	3	31
	TC metals	1311 for extraction followed by 6010B, 6020 or one or more of: 7060A/7061A/EPA206.3 7080A/7081/EPA208.1 7130/7131A/EPA213.1 7190/7191/EPA218.0 7420/7421/EPA239.1 7470A/7471A/EPA245.2 7740/7741A/EPA270.3 7760A/7761/EPA272.1	Normal	22[b]	1	33	3	0	3	29
Sub-total				176		176	6	3	6	191

Table A-2. Summary Estimate of Analytical Samples (Continued)

Sample Source	Analyte	Analytical Method	Turn Around Time	Number of Sampling Events	Samples per Event	Total Number of Samples	Duplicate Samples[a]	Replicate Samples[a]	Trip Blank	Grand Total
Liquids Waste Samples										
	Chemical agent	Extraction and GC/MSD or GC/FPD/ECD	Normal	66[c]	1	66	0	0	0	66
	Corrosivity (pH)	9040B, 9041A	Normal	66[c]	1	66	0	0	0	66
	Ignitability	1010 or 1020A	Normal	66[c]	1	66	0	0	0	66
	Heat of combustion	5050 or ASTM D5468-02	Normal	66[c]	1	66	0	0	0	66
	% Ash	ASTM D5468-02	Normal	66[c]	1	66	0	0	0	66
	Specific Gravity	ASTM D4052-96 D1429-95 or D1217-93	Normal	66[c]	1	66	0	0	0	66
	TC organics	8260B, 8270B, 8081A, or 8151A	Normal	66[c]	1	66	3	3	3	75
	TC metals	6010B, 6020 or one or more of: 7060A/7061/EPA206.3 7080/EPA208.1 7130/7131A/EPA213.1 7190/7191/EPA218.0 76607661/EPA239.1 7470A/7471A/EPA245.2 7740/7741A/EPA270.3 7760A/7761/EPA272.1	Normal	66[c]	1	66	3	0	3	72
Sub-total				528		528	6	3	6	543

Table A-2. Summary Estimate of Analytical Samples (Continued)

Sample Source	Analyte	Analytical Method	Turn Around Time	Number of Sampling Events	Samples per Event	Total Number of Samples	Duplicate Samples[a]	Replicate Samples[a]	Trip Blank	Grand Total
Used Filter Samples										
	Chemical agent	MINICAMS®	Normal	1	1	1	0	0	0	1
	TC metals	1311 for extraction followed by 6010B, 6020, or one or more of the following: 7060A/7061A/EPA206.3 7080A/7081/EPA208.1 7130/7131A/EPA213.1 7190/7191/EPA218.0 7420/7421/EPA239.1 7470A/7471A/EPA245.2 7740/7741A/EPA270.3 7760A/7761/EPA272.1	Normal	1	1	1	0	0	0	1
	TC organics	1311 and 8260B, 8270C, 8081A, and 8151A	Normal	1	1	1	0	0	0	1
	Heat of Combustion	5050 or ASTM D5468-02	Normal	1	1	1	0	0	0	1
	% Ash	ASTM D5468-02		1	1	1	0	0	0	1
Sub-total				5		5	0	0	0	5

Table A-2. Summary Estimate of Analytical Samples (Continued)

Sample Source	Analyte	Analytical Method	Turn Around Time	Number of Sampling Events	Samples per Event	Total Number of Samples	Duplicate Samples[a]	Replicate Samples[a]	Trip Blank	Grand Total
Unused Decontamination Solution										
	Corrosivity	9040B or 9041A	Normal	1	1	1	0	0	0	1
	Ignitability	1010 or 1020A	Normal	1	1	1	0	0	0	1
Sub-total				2		2	0	0	0	2
Used Decontaminated Disposable PPE										
	Chemical agent	MINICAMS	Normal	1	1	1	0	0	0	1
	TC metals	1311 for extraction followed by 6010B, 6020, or one or more of the following: 7060A/7061A/EPA206.3 7080A/7081/EPA208.1 7130/7131A/EPA213.1 7190/7191/EPA218.0 7420/7421/EPA239.1 7470A/7471A/EPA245.2 7740/7741A/EPA270.3 7760A/7761/EPA272.1		1	1	1	0	0	0	1
	TC organics	1311 and 8260B, 8270C, 8081A, and 8151A	Normal	1	1	1	0	0	0	1
Sub-total				3		3	0	0	0	3

Table A-2. Summary Estimate of Analytical Samples (Continued)

Sample Source	Analyte	Analytical Method	Turn Around Time	Number of Sampling Events	Samples per Event	Total Number of Samples	Duplicate Samples[a]	Replicate Samples[a]	Trip Blank	Grand Total
Aqueous Personnel Decontamination Station and VCS Closure Decontamination Rinsate										
	Chemical agent	GC/MSD or GC/FPD/ECD	Normal	1	1	1	0	0	0	1
	TC metals	1311 for extraction followed by 6010B, 6020, or one or more of the following: 7060A/7061A/EPA206.3 7080A/7081/EPA208.1 7130/7131A/EPA213.1 7190/7191/EPA218.0 7420/7421/EPA239.1 7470A/7471A/EPA245.2 7740/7741A/EPA270.3 7760A/7761/EPA272.1	Normal	1	1	1	0	0	0	1
	TC organics	5030B, 8021B, or 8260B	Normal	1	1	1	0	0	0	1
	pH	9040B of 9041A	Normal	1	1	1	0	0	0	1
	Corrosivity	1110		1	1	1	0	0	0	1
	Ignitability	1010 or 1020A	Normal	1	1	1	0	0	0	1
	% Ash	ASTM D5468-02	Normal	1	1	1	0	0	0	1
	Heat of combustion	ASTM D5468-02	Normal	1	1	1	0	0	0	1
	Specific gravity	ASTM D1429-95, D1217-93, or D5057-90	Normal	1	1	1	0	0	0	1
Sub-total				9		9	0	0	0	9

Table A-2. Summary Estimate of Analytical Samples (Continued)

Sample Source	Analyte	Analytical Method	Turn Around Time	Number of Sampling Events	Samples per Event	Total Number of Samples	Duplicate Samples[a]	Replicate Samples[a]	Trip Blank	Grand Total
Aqueous Detergent Wash										
	Corrosivity	1110	Normal	2	1	2	0	0	0	2
	TC metals	1311 for extraction followed by 6010B, 6020, or one or more of the following: 7060A/7061A/EPA206.3 7080A/7081/EPA208.1 7130/7131A/EPA213.1 7190/7191/EPA218.0 7420/7421/EPA239.1 7470A/7471A/EPA245.2 7740/7741A/EPA270.3 7760A/7761/EPA272.1	Normal	2	1	2	0	0	0	2
	TC organics	5030B, 8021B, or 8260B	Normal	2	1	2	0	0	0	2
	% Ash	ASTM D5468-02	Normal	2	1	2	0	0	0	2
	Heat of Combustion	ASTM D5468-02	Normal	2	1	2	0	0	0	2
Sub-total				10		10	0	0	0	10
Grand Total				733		733	6	3	6	748

Notes:

[a] Duplicate and replicate samples may be used to make matrix spike samples.
[b] Assumes one sample per item treated
[c] Assumes three waste drums per item treated, one sample per drum

ASTM = American Society for Testing and Materials
EPA = Environmental Protection Agency
GC/FPD/ECD = gas chromatograph/flame photometric detector/electron capture detector
GC/MSD = gas chromatograph/mass selective detector
PPE = personal protective equipment
TC = toxicity characteristic
VCS = Vapor Containment System

Table A-3. Summary of NRT, Confirmation, and Area Air Monitoring Samples

Sample Location	Analyte	Analytical Method	Turn Around Time	Number of Sampling Events	Samples per Event	Total Number of Samples	Replicate Samples	Duplicate Samples	Trip Blank	Total
NRT Monitoring										
EDS Unpack Area	HD/GB	MIINICAMS®	~10 min	66[a]	144[b]	9,504	66	0	0	9,570
EDS Door	HD/GB	MIINICAMS	~10 min	66[a]	144[b]	9,504	66	0	0	9,570
Air Monitoring Shed[a]	HD/GB	MIINICAMS	~10 min	66[a]	72[c]	4,752	66	0	0	4,818
Outside VCS[a]	HD/GB	MIINICAMS	~10 min	66[a]	72[c]	4,752	0[d]	0	0	4,752
Midbed Filtration System[b]	HD/GB	MIINICAMS	~10 min	66[a]	72[c]	4,752	66	0	0	4,818
Filtration System Exhaust[b]	HD/GB	MIINICAMS	~10 min	66[a]	72[c]	4,752	0[e]	0	0	4,752
PDS	HD/GB	CAM	seconds	Continuous	N/A	N/A	N/A	N/A	N/A	N/A
Confirmation Monitoring										
EDS Unpack Area	HD/GB	DAAMS/GC	15 min[f]	66[a]	1[f]	66	0	0	0	66
EDS Door	HD/GB	CAM	15 min[f]	66[a]	1[f]	66	0	0	0	66
Air Monitoring Shed	HD/GB	DAAMS/GC	15 min[f]	66[a]	1[f]	66	0	0	0	66

Table A-3. Summary of NRT, Confirmation, and Area Air Monitoring Samples (Continued)

Sample Location	Analyte	Analytical Method	Turn Around Time	Number of Sampling Events	Samples per Event	Total Number of Samples	Replicate Samples	Duplicate Samples	Trip Blank	Total
Confirmation Monitoring[c] (continued)										
Outside VCS	HD/GB	DAAMS/GC	15 min[f]	66[a]	1[f]	66	0	0	0	66
Midbed Filtration System	HD/GB	DAAMS/GC	15 min[f]	66[a]	1[f]	66	0	0	0	66
Filtration System Exhaust	HD/GB	DAAMS/GC	15 min[f]	66[a]	1[f]	66	0	0	0	66
Area Monitoring										
Air Monitoring Shed	HD/GB	DAAMS/GC	15 min[f]	66[a]	3	198	0	0	0	198
Outside VCS	HD/GB	DAAMS/GC	15 min[f]	66[a]	3	198	0	0	0	198
Closure/End of Campaign Decontamination Monitoring										
EDS Unpack Area	HD/GB	MINICAMS	15 min[f]	2	2	4	0	0	0	4
Clean Closure Monitoring										
PDS	HD/GB	DAAMS/GC	15 min[f]	1	1	1	0	0	0	1
Air Monitoring Shed	HD/GB	DAAMS/GC	15 min[f]	1	1	1	0	0	0	1
VCS Filter Housing	HD/GB	DAAMS/GC	15 min[f]	1	1	1	0	0	0	1

Table A-3. Summary of NRT, Confirmation, and Area Air Monitoring Samples (Continued)

Notes:

[a] Assumes three days of monitoring per item destroyed in EDS
[b] Assumes one sample ever 10 minutes
[c] Assumes one sample every 20 minutes (MINICAMS® is being shared between two monitoring locations.)
[d] The same MINICAMS will be used to monitor the monitoring room and the area outside the VCS. A stream selection device will alternate between the two monitoring locations. Therefore, the number of samples collected at either location is half of the number of samples collected at locations with dedicated MINICAMS. The field matrix spike samples are all reported under the Air Monitoring Room location.
[e] The same MINICAMS is used to monitor the filter midbed and the exhaust stack. A stream selection device alternates the air stream flow to the monitor between the two locations. Therefore, the number of samples for each location is half that of the locations with dedicated monitors. The field matrix spike samples are all reported under the filter midbed sampling location.
[f] Sample analysis time is approximately 15 minutes. Time needed to collect sample is variable and time needed to transport sample to laboratory for analysis depends on how far laboratory is from EDS.

DAAMS	=	Depot Area Air Monitoring System
EDS	=	Explosive Destruction System
GB	=	nerve agent
GC	=	gas chromatograph
HD	=	mustard agent
NRT	=	near real-time
PDS	=	personnel decontamination station
VCS	=	Vapor Containment System

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ATTACHMENT B

CALIBRATION AND CHALLENGE CALCULATIONS

ATTACHMENT B

CALIBRATION AND CHALLENGE CALCULATIONS

List of abbreviations used in these calculations

AEL	=	airborne exposure limit
L	=	liter
µg/mg	=	microgram per milligram
µL	=	microliter
mg/m^3	=	milligram per cubic meter
min	=	minute
mL	=	milliliter
mL/min	=	milliliter per minute
ng	=	nanogram
ng/µg	=	nanogram per microgram
ng/µL	=	nanogram per microliter

Air monitors must be able to detect analytes at the AEL for each analyte. Therefore, calibrations and challenges to the air monitors are conducted with an amount of standard solution (or gas) that will produce a 1.0 AEL response from the monitor.

Calculations for Liquid Standards

For sulfur mustard (HD), nerve agent (GB) an analyte solution is used for calibration and challenge.

Given: (using HD for example)

AEL	=	$0.003\ mg/m^3$
Cycle time	=	6 min
Flow rate	=	150 mL/min
Concentration of standard solution	=	1.1 ng/µL

The mass of analyte required is calculated as follows:

Mass of analyte = AEL × cycle time × flow rate × conversion factors

Using HD example:

$$\text{Mass of analyte} = 0.003\ mg/m^3 \times 6\ min \times 150\ mL/min \times (1m^3/1{,}000\ L \times 1L/1{,}000\ mL \times 1{,}000\ \mu g/mg \times 1{,}000\ ng/\mu g$$

$$= 2.7\ ng$$

This calculation determines the mass of analyte that would be collected in the sorbent tube during one sampling cycle under the given conditions of cycle time and flow rate if the air contained 1.0 AEL of the analyte. Calculations for other concentrations may be performed by multiplying the mass of analyte needed to make a 1.0 AEL standard solution by a factor equal to the portion of the AEL that is desired. For example, to calculate the concentration for a standard solution at 0.2 AEL, multiply the mass of analyte needed for a 1.0 AEL solution by 0.2.

The volume of standard solution that must be injected into the monitor to produce a 1.0 AEL response is calculated as follows:

Volume of standard = mass of analyte/concentration of analyte in the standard

Using HD example:

$$\text{Volume of standard} = 2.7\ \text{ng}/1.1\ \text{ng}/\mu\text{L}$$
$$= 2.45\ \mu\text{L}$$

The standard solutions for chemical agents are prepared by ECBC. The concentration of agent in the standard solution may vary from batch to batch; therefore, this calculation must be made for each new lot of analyte using the concentration value for that lot.